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DoD M&S Progress Report

23 May 1996

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Director, Defense Modeling and Simulation Office

M&S Critical to DoD's Ability to Meet its Mission

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Continuing squeeze on DoD resources

- shrinking, dispersed force structure
- competition for O&M funds limits field exercises
- need to carefully examine every investment

More demanding operational requirements

- new, more complex missions
- vastly expanding mission space
- increased complexity of systems and plans
- increasing demand for joint training
- security challenges (e.g., information warfare)
- no traditional way to address

Much more technical capability at less cost

- communications
- computers
- advanced software technology
- displays/human-machine interfaces
- data storage and management

What's Happening

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- New simulation programs (JSIMS, JWARS, JTCTS, et. al.) making good progress
- Executive Council for M&S (EXCIMS) established senior level councils for training, analysis, & acquisition
- DoD M&S Master Plan approved (October 1995)
  - Functional Area Appendices in development
- Succession of exercises supported by simulation
  - Atlantic Resolve
  - Kernal Blitz
  - Prairie Warrior
  - ULCHI-Focus Lens
  - United Endeavor
  - Others

continued

What's Happening

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continued

- **Four DoD M&S Executive Agents appointed**
  - **DMA - terrain**
  - **Navy - oceans**
  - **Air Force - air & space**
  - **DIA - foreign force & Nat'l/Joint intelligence representations**
- **Budget pressures (e.g., PBD 870)**
  - **Increasing management attention**
  - **Must prove return on investment**
- **DoD M&S Master Plan execution on track, yielding important benefits**
- **Unprecedented level of cooperation across DoD**

DoD M&S Strategy: An Analogy to City Planning

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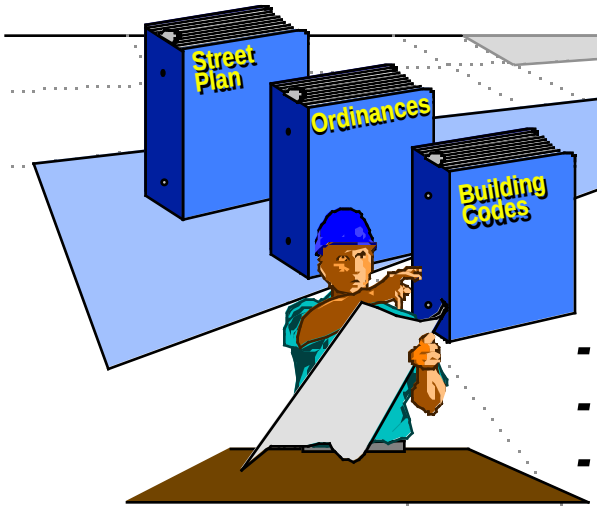
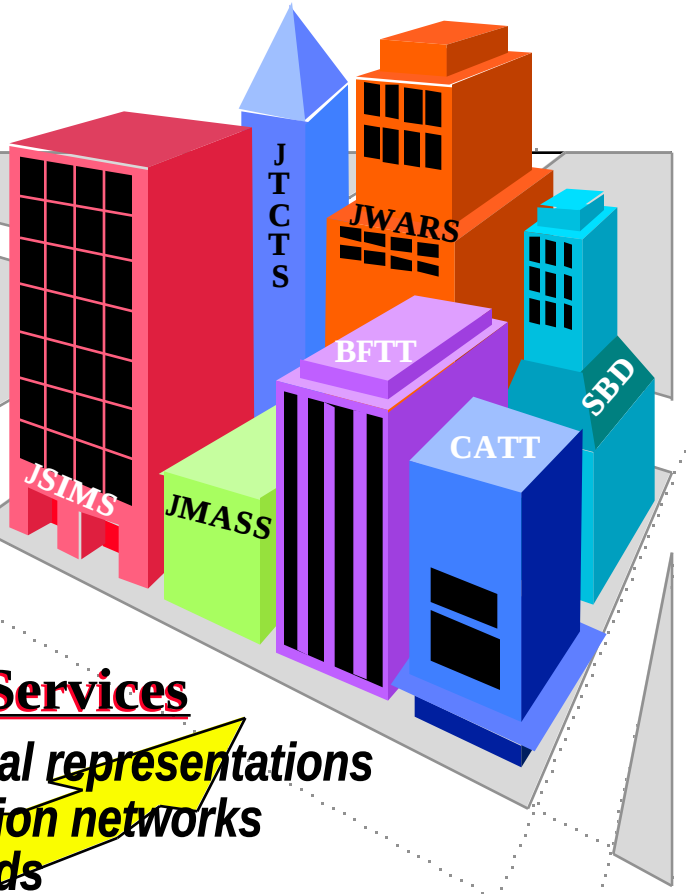
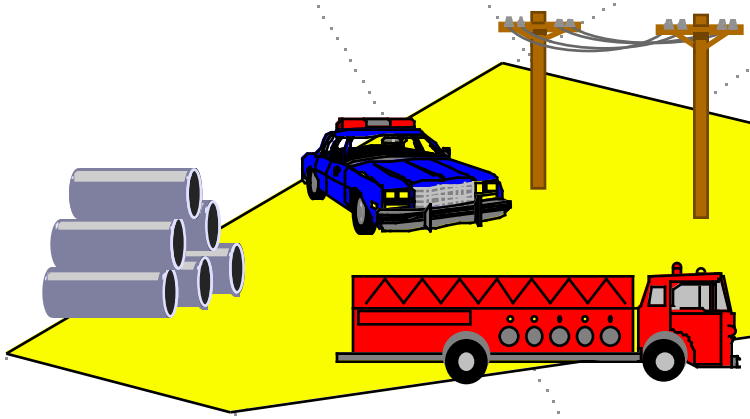


Technical Framework

- *High Level Architecture*
- *CMMS (common world view)*
- *Data standards*





Common Services

- *Environmental representations*
- *Communication networks*
- *VV&A methods*
- *Repositories*
- *Help Desk*
- *Education*

Payoffs: Interoperability and reuse = capability and cost-effectiveness

DoD M&S Master Plan

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Objective 1	*Objective 2*	*Objective 3*	*Objective 4*	*Objective 5*	*Objective 6*
Develop a common technical framework for M&S	Provide timely and authoritative representations of the natural environment	Provide authoritative representations of systems	Provide authoritative representations of human behavior	Establish a M&S infrastructure to meet developer and end-user needs	Share the benefits of M&S
Sub-objectives	***Sub-objectives***		***Sub-objectives***	***Sub-objectives***	***Sub-objectives***
1-1 High-level architecture	2-1 Terrain		4-1 Individuals	5-1 Field systems	6-1 Quantify impact
1-2 Conceptual models of the mission space	2-2 Oceans		4-2 Groups and organizations	5-2 VV&A	6-2 Education
1-3 Data standardization	2-3 Atmosphere			5-3 Repositories	6-3 Dual-use
	2-4 Space			5-4 Communications	
				5-5 Coordination Center	

signed out by USD (A&T) on 17 October 1995

Diverse Simulation Applications under an Overarching Technical Framework

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Master Plan's Technical Framework

High Level Architecture, Conceptual Models of the Mission Space, Data Standards

Domain-specific aspects

- Analytical Simulations
- Training Simulations
- Instrumented Ranges
- Real Weapon Systems and C4I
- Engineering Level (R&D, T&E) Simulations and Manufacturing
- Other Simulations

Technology Development

DoD M&S Master Plan Objective 1-1

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Objective 1-1

Establish a common high-level simulation architecture to facilitate the interoperability of all types of models and simulations among themselves and with C4I systems, as well as to facilitate the reuse of M&S components

- **Simulations developed for particular DoD Components or Functional Areas must conform to the High Level Architecture**
- **Further definition and detailed implementation of specific simulation system architectures remain the responsibility of the developing Component**

C4I-Sim Operational Concept

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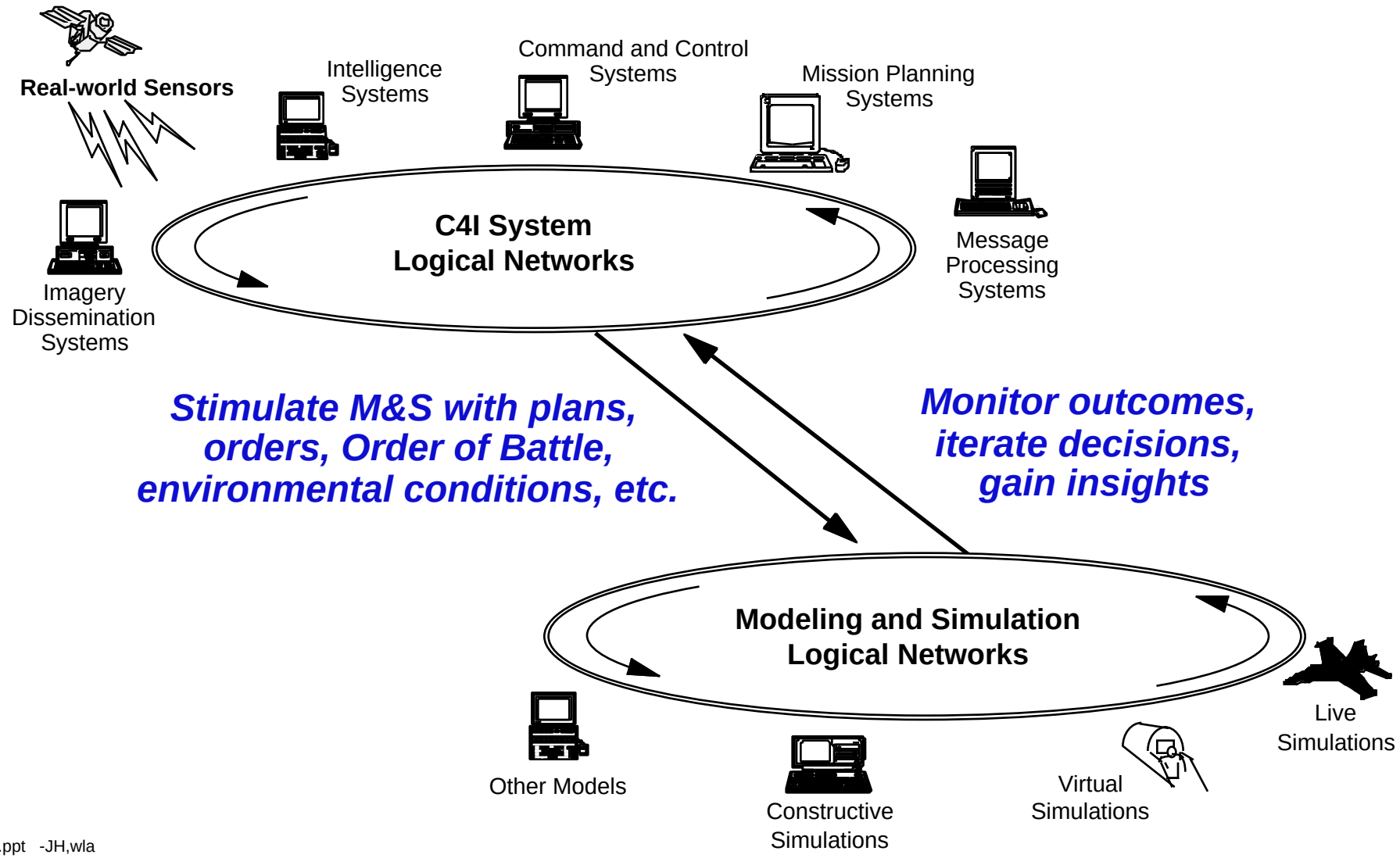

High-Level Architecture Definition Process

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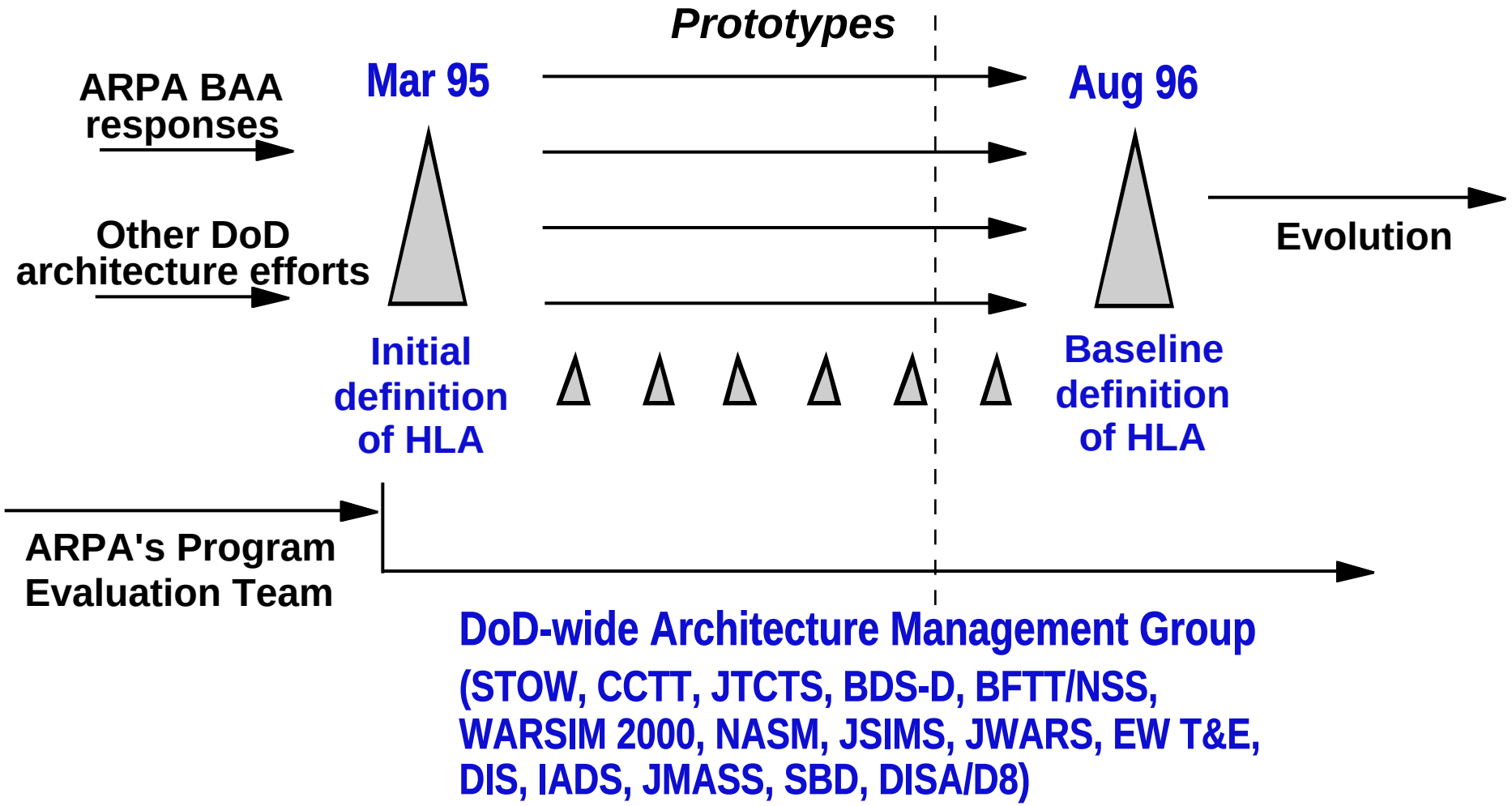

Functional View of the Architecture

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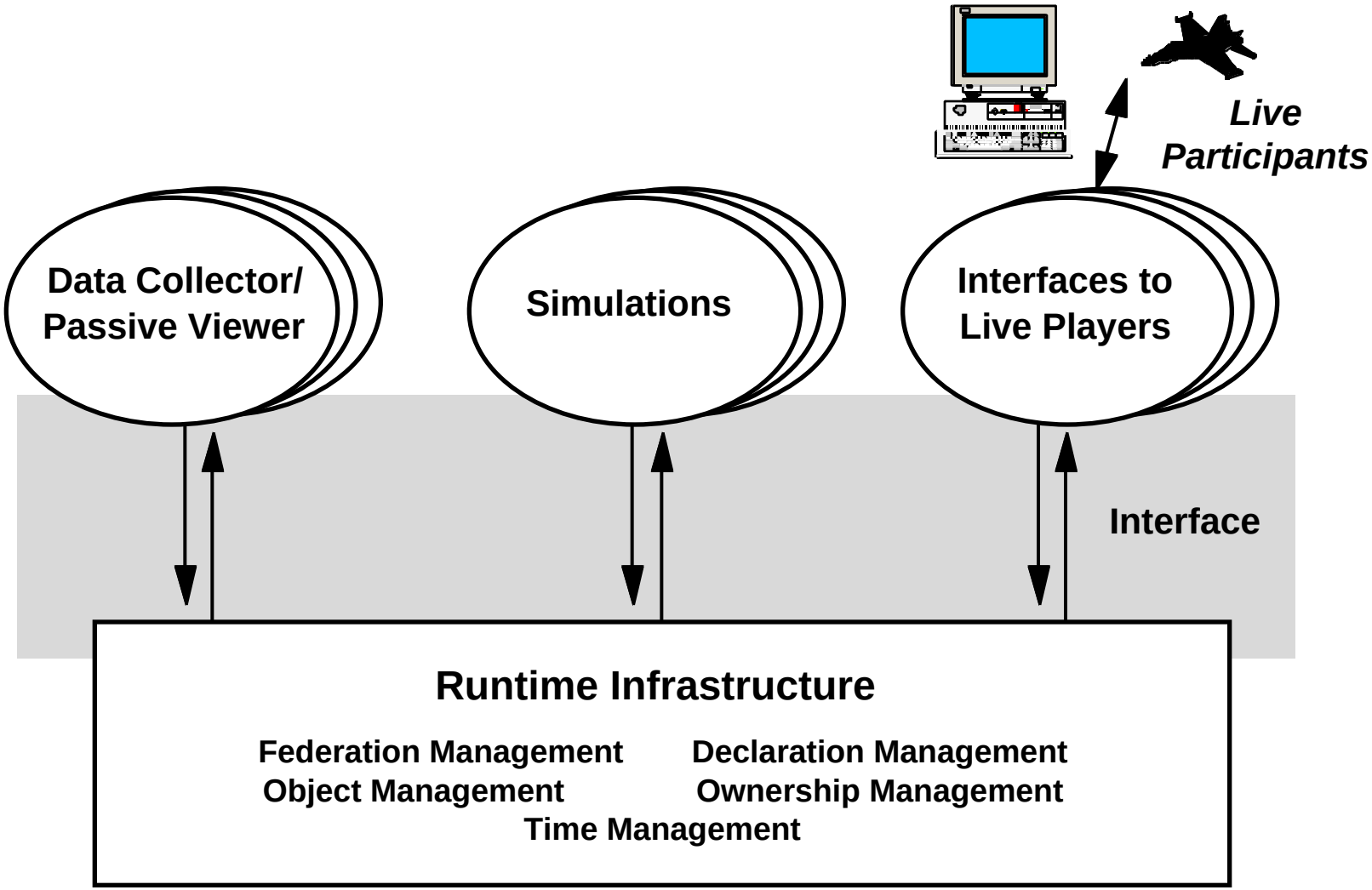

HLA Progress to Date

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- AMG forum a big success, with superb technical exchange. Eleven meetings thus far.
- Several iterations of HLA documents released, on WWW
- Supporting software efforts on track
  - Runtime Infrastructure (RTI) version 0.3 released
  - Modular Reconfigurable C4I Interface (MRCI) under development
- Prototypes using the HLA are already running on the RTI and DSI. First combat interaction of dissimilar simulations on 11 Mar 96
- HLA benefits increasingly understood, further solidifying support and enthusiasm. Commercial products emerging.
- On schedule to establish Baseline HLA definition in Aug 96
- IEEE DIS standards organization is reorganizing to support entire M&S community with DIS++ standards built around HLA

Fostering Cost Effectiveness through Reuse and Direct Support

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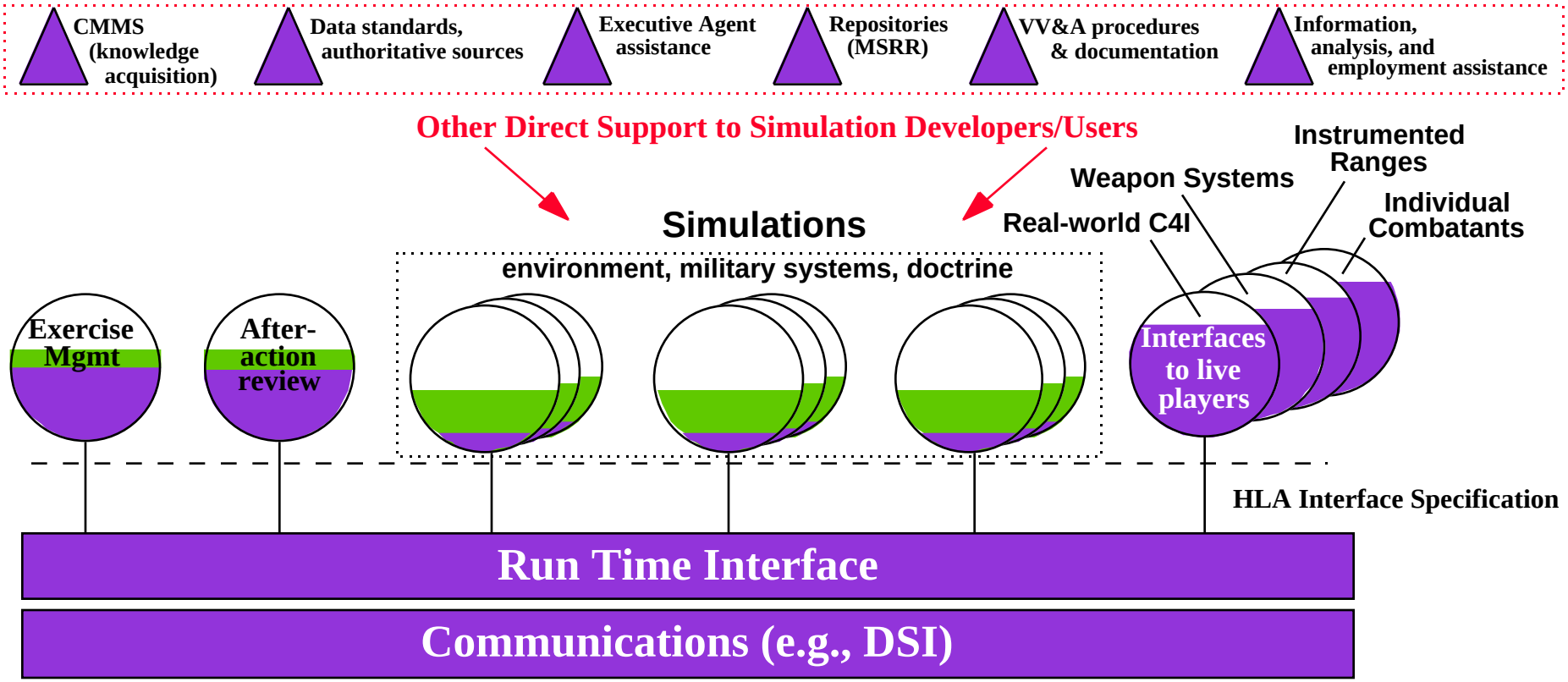

Key:

- reusable across all DoD simulation systems
- reusable across a simulation domain
- system-specific

HLA Transition

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- Establishment of a baseline HLA definition marks the beginning of an important transition process
- As required by the Master Plan, DoD Components and Agencies are responsible for reviewing their programs and planning for transition of new and continuing programs to HLA
- There are a series of activities which are key to this transition process
  - AMG Management of HLA Transition
  - Development of Supporting SW
  - Compliance Certification Process
  - IEEE DIS Standards Transition
  - Technology Experimentation
  - Education and Training

Modular Reconfigurable C4I Interface Notional Design

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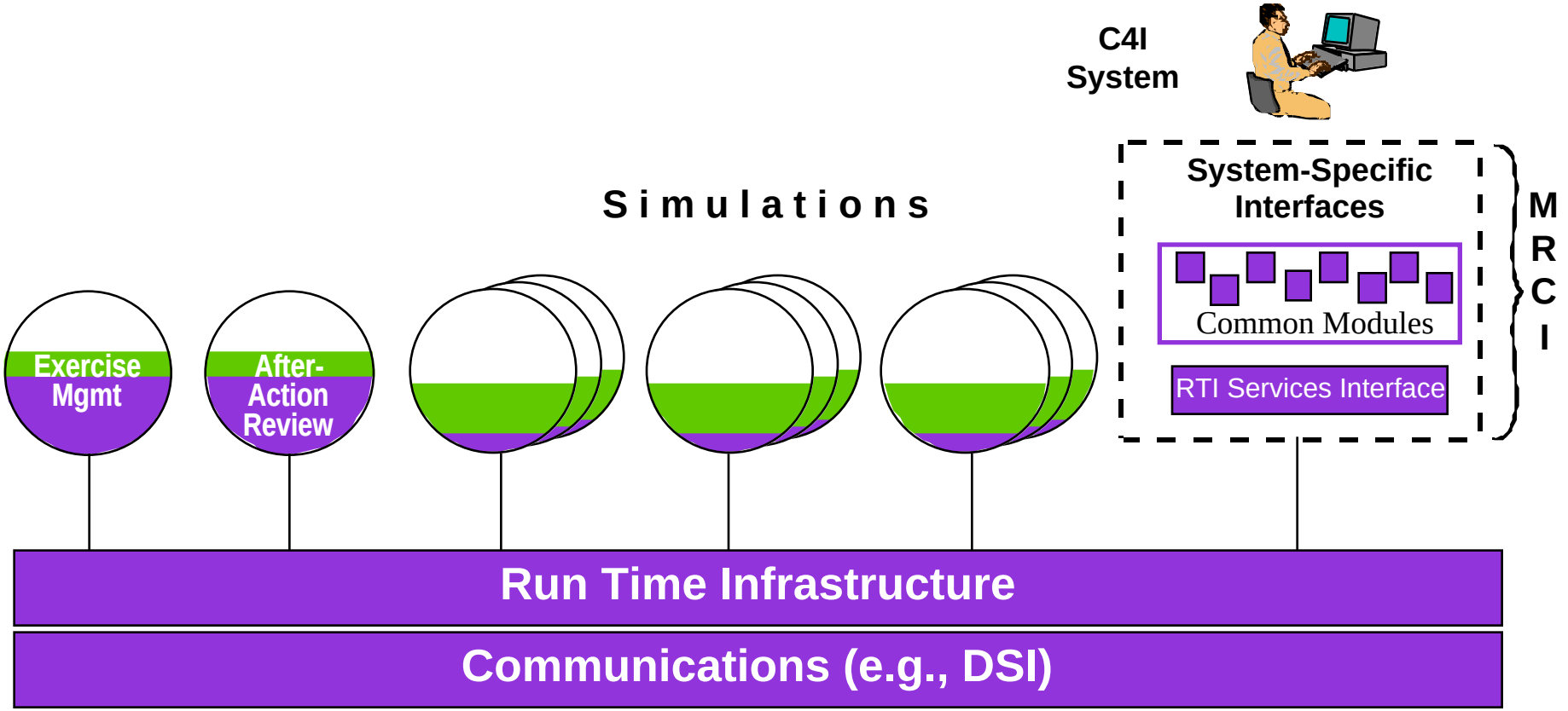

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What is a CMMS?

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- A hierarchical description of the actions and interactions among the various entities associated with a particular mission area
- An authoritative first abstraction of the real world
- A common framework for knowledge acquisition
  - Validated, relevant actions and interactions organized by specific task and entity/organization
  - Standard format for expression
- The purpose of CMMS is to cost-effectively provide simulation developers (and others) a common understanding of the real world

CMMS

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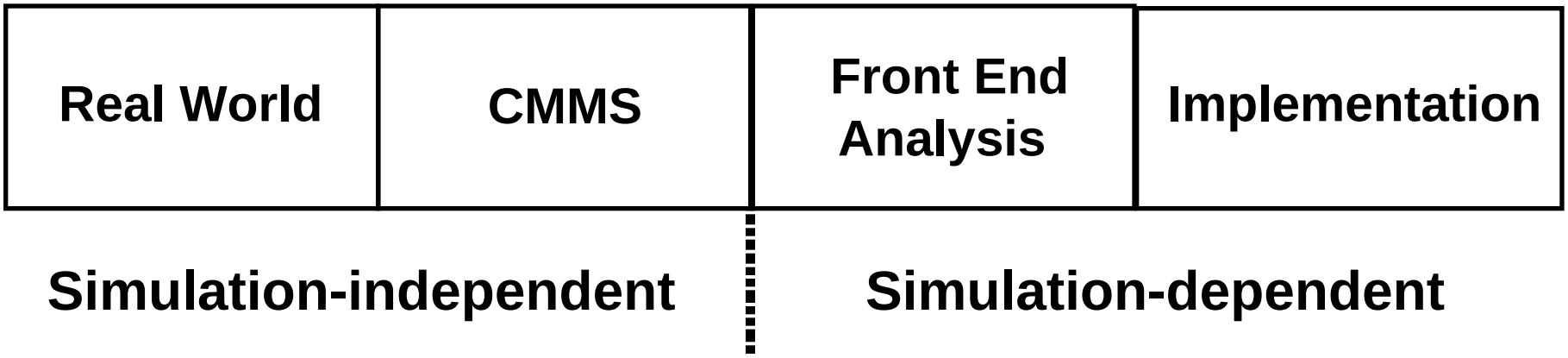
Simulation Development Process



Organizational Concept

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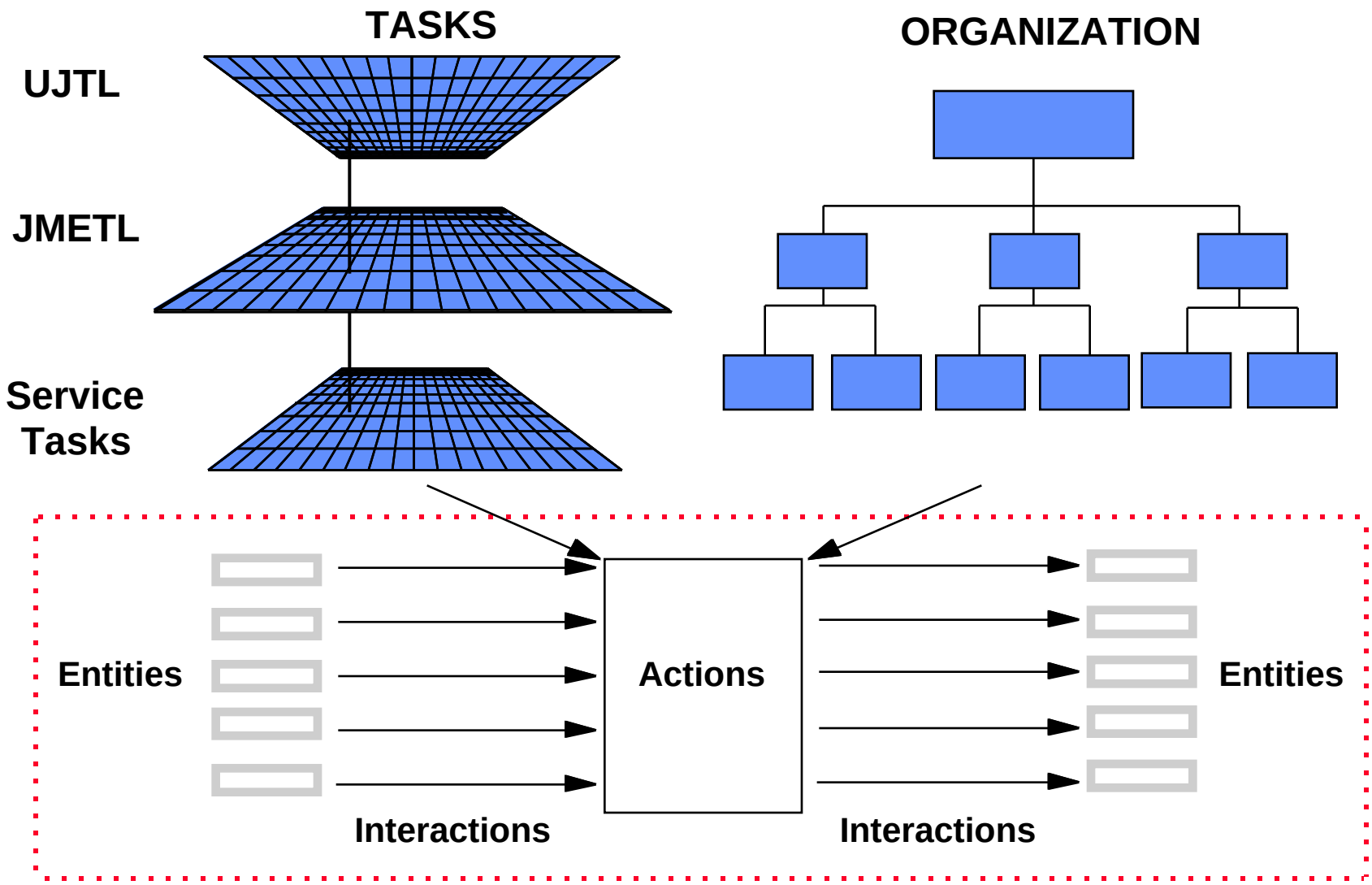

CMMS Progress

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- JSIMS, JWARS, NASM, WARSIM, and others are working together in domain analysis/knowledge acquisition, saving time and effort
- Draft technical structure for CMMS completed
- An automated suite of tools is under development to provide data integration, configuration management, viewing and query capabilities
  - Experimental phase complete - demo software available
  - Prototype phase underway - 2 spirals - completion in Mar 97
  - Full CMMS capability (partially populated) - late 97/early 98

Data Standards

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- **Four thrusts**
  - Identification of authoritative data sources (ADS)
  - Establishing standard data interchange formats (DIF)
  - Providing VV&A procedures and tools to ensure data quality
  - Establishing data security policy

- **1995 accomplishments**
  - Nominated 3300 data elements to DoD
  - Developed DIS data dictionary
  - Developed reverse engineering methodology for migrating legacy databases
  - ADS catalog of about 200 data sources accessible through MSRR
  - Developing data VV&C guidelines to support data users and suppliers

continued

Data Standards

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continued

- **FY96 actions**
  - **Provide existing data standards on MSRR**
  - **Develop new data interchange formats (DIFs)**
  - **Focused on discrete tasks (e.g., CMMS, SEDRIS, MRCI, OMT)**
  - **Continue to populate list of Component-approved ADS**
  - **Complete development of data VV&C guidelines, then test them with nominated candidate programs before formal coordination**
  - **Develop a cross-platform Data Quality Engineering tool**

What is an Environmental MSEA?

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- Authority derived from DoDD 5000.59 to serve the M&S community with specific focus on:
  - Common- and general-use M&S applications to authoritatively represent the natural environment:
    - Foster interoperability and reuse in the generation, interchange, and use of dynamic synthetic environments.
    - Facilitate development of a responsive means to acquire environmental data from a range of data producers and data repositories.
  - Supporting M&S system development and standardization processes as a facilitator in the program start-up phase, a catalyst during development, and a certifier in the capability delivery phase.

MSEA Customers

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A broad spectrum, from developers of major M&S training, analysis, and acquisition systems, through simulation and exercise managers at all levels, to the individual user of M&S technology in distributed locations:

- **JSIMS, JWARS, WARSIM, BFTT, JTCTS, NASM, NSS, JMASS, other key developing systems**
- **Legacy systems: Joint Training Confederation models, others**
- **Weapons/support system simulations/simulators**
- **Various analytical cells, doctrine development simulation facilities, and engineering centers**

Program Areas

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- **Requirements: Capture M&S data and model requirements and related information through interaction with M&S community:**
  - **Assist exploitation of data and models in M&S systems.**
  - **Provide feedback and technical requirements to data and model producers to enhance production base output.**
  - **Participate in M&S exercises, working groups, and other forums.**
- **Standards: Promote interoperability, reuse, cost-effectiveness and timely delivery:**
  - **Define and coordinate standards for algorithms, data and metadata content, and data interchange.**
- **Technology: Foster development of capabilities to: (1) produce integrated data packages rapidly, efficiently, and economically; (2) depict the data accurately in multidimensional and dynamic representations.**
  - **Assist in the test and evaluation of prototype products and new applications in operational and developing M&S systems.**
  - **Use evolving certification and software accreditation procedures.**

MSEA Principals

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Terrain	Oceans	Air/Space
Director, Defense Mapping Agency (O-8)	Oceanographer of the Navy (N-096) (O-8)	USAF Director of Weather (XOW) (O-7)
Chief, Customer Support Division Acquisition and Technology Group (SES)	Technical Director (N-096) (SES)	Commander, Air Weather Service (O-6)
Chief, Terrain Modeling Project Office (TMPO) (SES)	Program Manager Oceans Executive Agent (GS-15)	Commander, Air Force Combat Climatology Center (AFCCC) (O-6)

Master Environmental Library

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- **Objectives:**
  - **Deliver authoritative data in standard formats and models to M&S systems to promote interoperability and reuse.**
    - **Develop a library architecture for environmental data and models.**
    - **Establish a standard process for documenting metadata descriptions.**
    - **Provide data viewer capability.**
  - **Define data quality review processes.**
- **Deliverables:**
  - **Initial MEL capability** **Oct 1995**
  - **Implementation of metadata descriptions in SGML** **Aug 1996**
  - **Integrated as a domain of MSRR** **Dec 1996**
  - **Data consistency review capabilities established** **Oct 1997**

Rapid Generation Initiatives

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- **Objective: Sponsor technology initiatives to generate authoritative source data packages for M&S systems and meet 96 hour crisis/mission rehearsal requirements.**

- **Initiatives:**
  - **Feature-integrated Triangulated Irregular Networks (TINs)**
  - **High-resolution database generation in urban environments**
  - **Extraction of elevation & feature data using knowledge-based rules**
  - **Commercial stand-alone data extraction system test**
  - **Integrated database generation for the surf zone**
  - **Fast propagation of electromagnetic energy**
  - **Expanded use of commercial sources and production technology**

Commercial End-to-End Production

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- **Objectives: Test alternative production methods and data sources by evaluating output from commercial producers.**
- **Initiatives:**
  - **DoE Airborne Multisensor Pod System (AMPS): An integrated suite of commercial sensors (3 multi/hyperspectral sensors, Synthetic Aperture Radar (SAR), thermal sensor, and large format frame camera) on one imaging airborne platform.**
  - **Vexcel, Inc: Algorithms/techniques for automated classification and feature identification in rapid mapping using SAR interferometry data.**
  - **Kestrel Corporation: Hyperspectral sensor (airborne, and potentially spaceborne) collection device. The airborne sensor has a high resolution collection capability of less than one meter (at 3,000 feet above ground level).**
- **Deliverables: Database development area and schedules are in negotiation.**

Sharing M&S Databases

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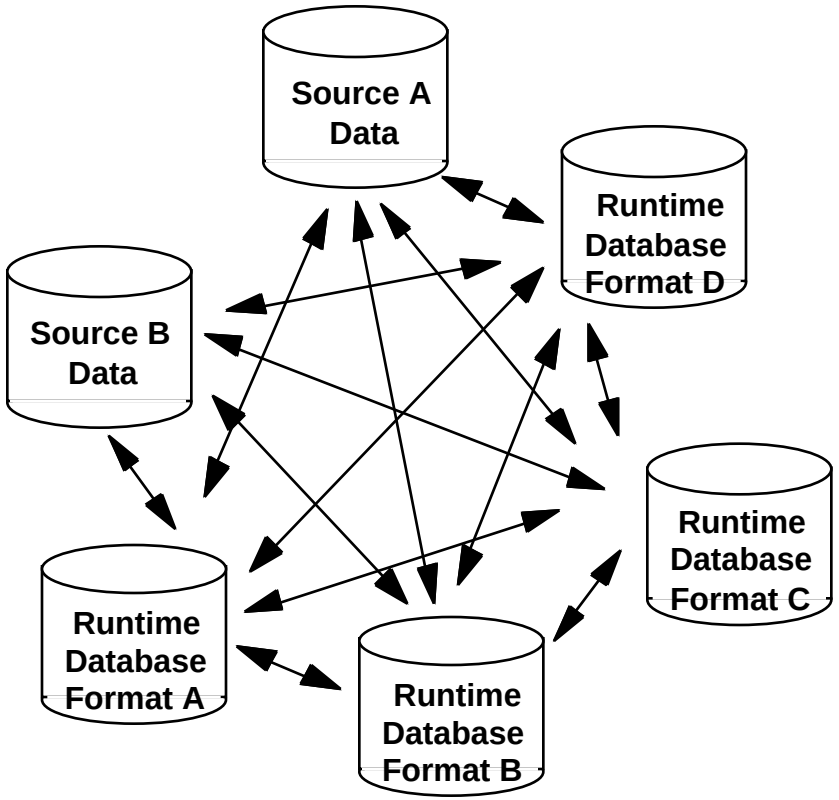
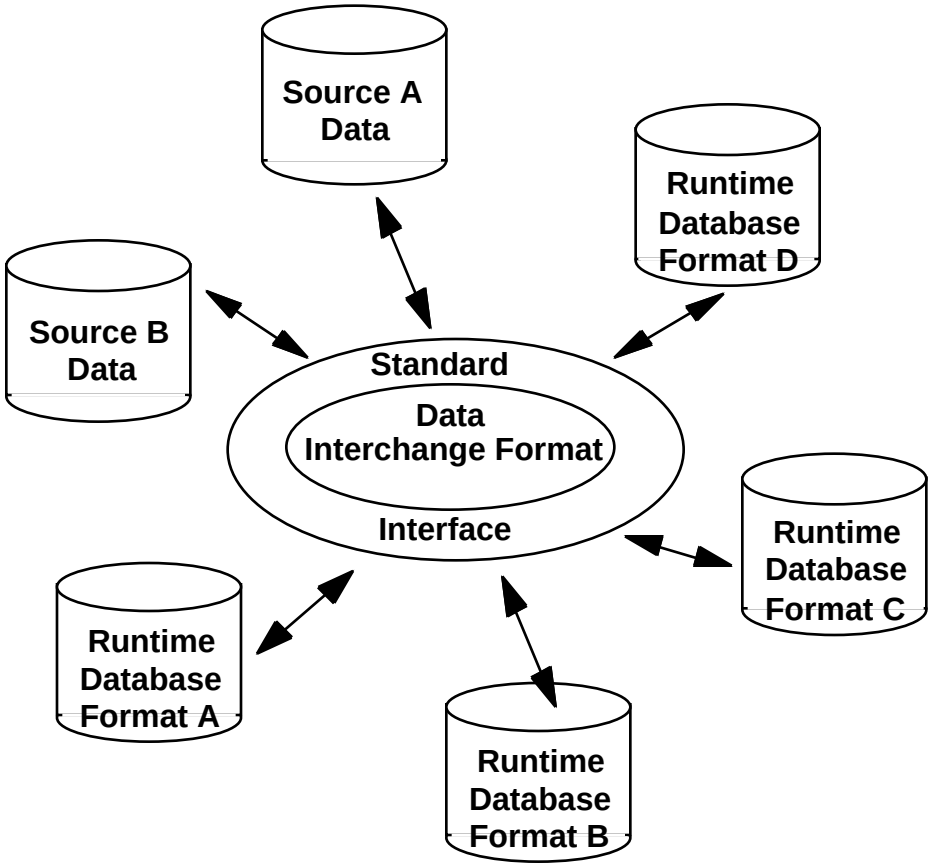


Today



Future

★ Every arrow denotes a conversion

SEDRIS

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- **Objective: Provide a standard interchange through a Synthetic Environment and Data Representation Interchange Specification to promote interoperability and reuse. Specifically SEDRIS will:**
  - **Articulate representation requirements for all environmental attributes (e.g., visual appearance, trafficability, reflectivity, emissivity, etc.)**
  - **Define data elements and relationships in a data representation model.**
  - **Support the complete range of interaction among heterogeneous simulations by providing a standard means of interchange as loss-free and complete as possible.**
- **Deliverables:**
  - **Initial data representation model and BAA** — **Nov 1995**
  - **Object oriented data representation model defined** — **Apr 1996**
  - **Initial read & write Application Programmer Interface** — **Jan 1997**
  - **Final data representation model** — **Apr 1997**
  - **SEDRIS format and baseline APIs** — **Jun 1997**

The MSEA process is working...

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- Proactive in a customer-oriented approach.
- Executing plans in accordance with a common business model.
- Focused on providing near-term deliverables.
- Addressing the tough problems now and for the future.
- Working together to ensure complete and seamless representations.
- Delivering benefits to simulation developers and users today!

Human Behavior Representations

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- A very difficult, but critically important area of modeling
- FY96 strategy is to determine current position, craft a course
  - Convening focused technical workshops to assess current state of the practice in key areas
    - C2 Decision Making in Combat Simulations (Feb 96)
    - Individual Combatant (1-2 Jul 96)
    - Unit Behavioral Representation Workshop (7-8 Aug 96)
  - Sponsoring Computer Generated Forces Workshop (23-25 Jul 96)
  - Publishing a catalog of current HBR technology programs
  - Initiating National Research Council Study/Workshop
- Will craft roadmap, initiate appropriate actions

Modeling and Simulation Resource Repository *(MSRR)*

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- **A distributed network of information resources, organized by domains, maintained by owners, and linked via WWW protocols**
- **Serve data providers and simulation developers, users, and managers**
- **Resources will include databases, metadata, CMMS, simulation and federation object models, VV&A histories, standards, software, etc.**
- **Contents registered and configuration managed; search capability**
- **Schedule**
  - **ten servers being integrated this year**
  - **supporting software suite under development by EPG**
  - **UNCLAS system operating, with basic services, by Dec 96 over Internet**
  - **prototype classified system in operation by Dec 96, with connectivity via SIPRNET and DSI**

MSRR Dec 1996 Snapshot

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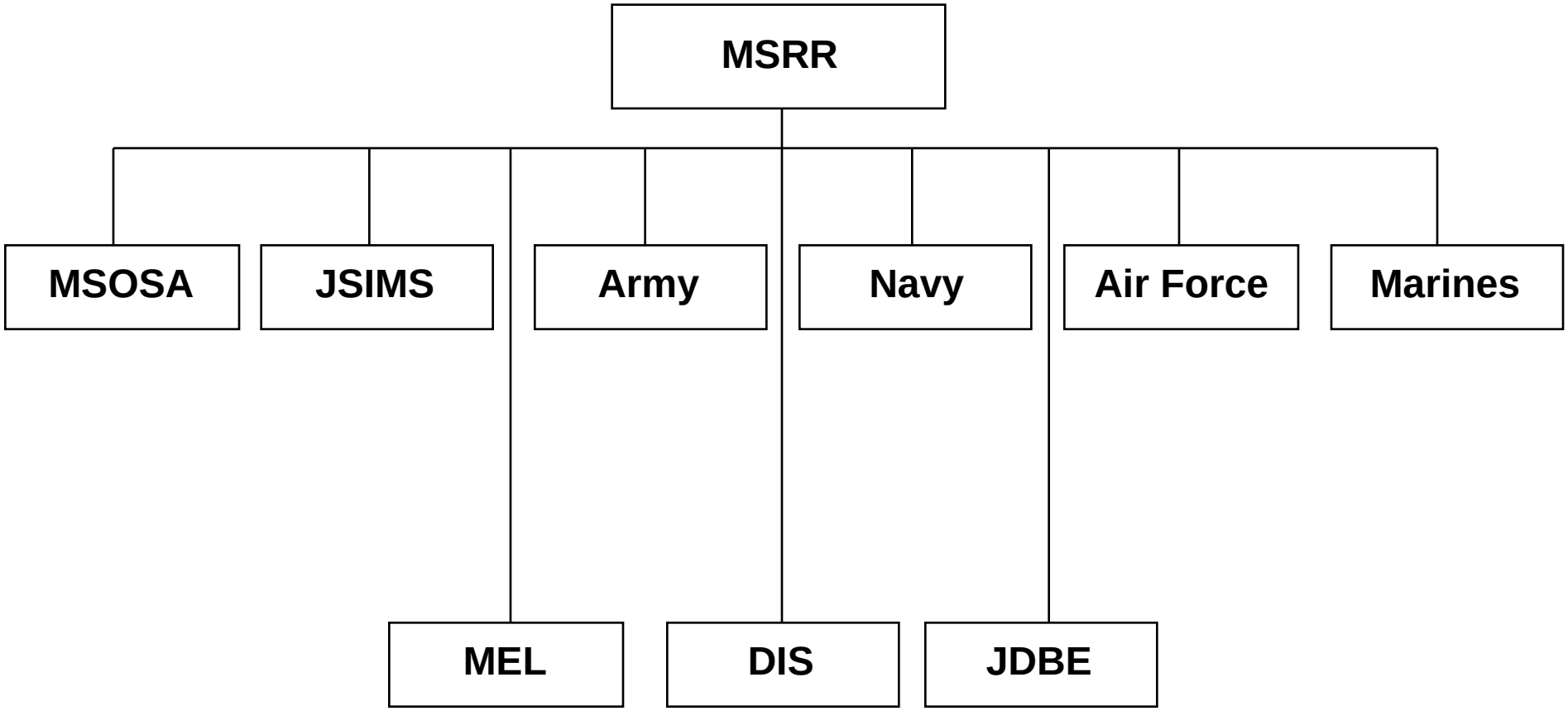

Verification, Validation, and Accreditation *(VV&A)*

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- **DoDI on VV&A policy completed formal coordination on 4 March 1996 and is being processed for final signature.**
- **VV&A Technical Support Team completing initial sections of draft DoD Recommended Practices Guide**
- **VV&A Assessment Team, consisting of 11 programs, will then review/test these recommended practices for refinement before formal publication.**

Prototype MSOSA Status

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Day 1
(4Dec 95)

115

65
M&S
Activities

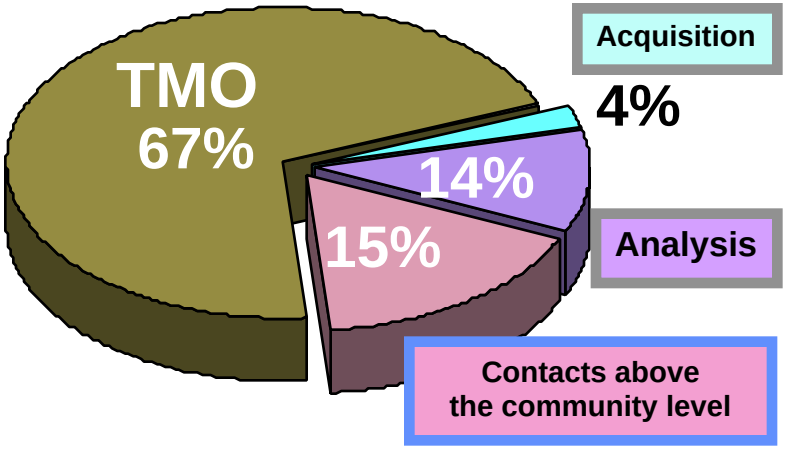
Contacts to Date!

715

299 M&S
Activities

**Where We Are
As of Week 24**
(17 May 96)

**Community Representation
(Requests for Assistance)**



313 Requests for M&S Assistance

- 186 Actions
- 111 Cases
- 16 Pending Requests

$ Estimated Customer Savings To Date: $1.8M

Summary

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- There is no viable alternative to robust use of M&S in our future
- Charted course is strategically and technically sound
- Unprecedented teamwork and synergy across M&S community
- Major achievements towards interoperable, reusable, affordable M&S